INDUCTION DIFFUSER

This invention relates to an induction diffuser or induction air handling unit and in particular to a diffuser where primary air flow induces secondary air flow that combines with the primary air flow to cause flow of both primary and secondary air from an air outlet.

BACKGROUND OF THE INVENTION

Known air-conditioning systems treat predominantly outside air that is mixed with a proportion of return air from within the building. This conditioned air is then used to meet the heating or cooling load within a particular space such as a number of rooms on a floor or an open space area on a floor of a building. The air supplied into a space is normally treated in one or more air handling plants before it is ducted to discharge points or registers in the ceiling of the room or space to be heated or cooled.

Normally, an air-conditioning system provides the whole of the treated air at a modest pressure from the air-conditioning plant room through ducts mounted above ceilings to ceiling mounted air registers distributed throughout the space. The ducts in the ceiling necessarily have a relatively large cross-sectional area because they convey the whole of the conditioned air at a low pressure.

Ducts having a large cross-sectional area tend to dictate the required height of the ceiling space and therefore will influence the required slab to slab spacing in multi-storey buildings. Thus, the size of the air-conditioning ducts in a ceiling has a major influence on the number of building floors that can be built for a given height which could be quite detrimental in cities that have restrictions on building height. It would be possible on some buildings to incorporate an additional floor if ceiling space height could be reduced for each floor. It is an aim of this invention to provide

an air-conditioning system that can minimise the cross-sectional area of air-conditioning duct work.

Fans are known to be the single largest consumer of energy within air-conditioning systems. This is due to the large volume of air which is moved through ducts to achieve the required heating or cooling effect. It is an aim of this invention to provide an air-conditioning system which reduces the amount of conditioned air which is circulated within an air-conditioning system.

Stratification is another significant problem with existing air-conditioning systems. This is where a very cold or very warm air is dumped into a room and settles, in the case of cold air along the floor, or in the case of hot air towards the ceiling. The problem is at its worst when there is a great temperature difference between the conditioned air and the space into which it flows. Cold air with a large temperature difference by comparison to the conditioned space will be much denser. Accordingly, it will sink rapidly towards the floor without effective mixing. This produces a very uncomfortable environment due to inefficient mixing of cold air. It is a further aim of this invention to overcome stratification problems.

SUMMARY OF THE INVENTION

In its broadest form, the invention is an induction air handling unit that in use has a primary air flow to induce a secondary air flow comprising;

a primary air supply chamber from which primary air flow is re-directed,

an outlet nozzle on said supply chamber that re-directs a jet of primary air away from said supply chamber,

a partition dividing a space into a first and second region, said supply chamber positioned in said first region, and

an air outlet in said partition having an aperture which said jet of primary air is directed so that a secondary airflow is caused to flow from within said first region into said second region.

Preferably, a plurality of nozzles are provided, each providing a jet of primary air that is directed towards the outlet. An example of a nozzle is described in Australian Patent No. 693661. This nozzle uses a shaped outlet to reduce noise and to also augment entrainment of air from the surroundings into the jet of primary air. However, this invention is not restricted to such a nozzle. Plain nozzle outlet shapes such as circular elliptical or any other shape would be suitable.

In a case of a plurality of nozzles, they may be arranged so as to form an elongate row and the outlet may be shaped accordingly. Alternatively, the primary air supply chamber and nozzles may be configured to suit a square or rectangular outlet such as a conventional ceiling mounted register. Other outlets having circular or irregular shapes can also be used. The supply chamber may be a specific chamber connected to ducts that feed primary air into the chamber. Alternatively, the chamber may be part of a duct with the outlet nozzle or nozzles attached directly to the duct.

The outlet may be provided with a plurality of vanes to assist in directing of the air as it moves away from the outlet. In addition, the outlet may be provided with walls that extend towards the nozzles which aid in the containment of the air prior to it exiting the outlet. A gap is provided between the walls and the primary air supply chamber to allow induced secondary air to flow in towards the jet or jets.

In the case of a square or rectangular register, secondary air may be allowed to flow from the second region through a central duct or opening in the outlet. This air flows to a point adjacent to the nozzle or nozzles where it is then entrained into the primary air flowing from the jets. Other means may be provided to allow secondary air to flow to a position where it may be induced into the primary air flow, but typically apertures may be provided in the partition which allow air to flow from the second region into the first region where it can then become entrained with the primary air flow. A pair of outlets may be used in conjunction with a combined light

fitting. In this case, an outlet is positioned either side of the light fitting which itself may be attached to the air handling unit.

Preferably, the partition comprises a ceiling within a room, but could also comprise a wall or floor with the primary air supply chamber located behind the wall or beneath the floor. In addition, the first region may be external to a building so that the secondary air flow is in fact outdoor air with the primary air being treated return air from the building.

In order to further describe the invention, preferred embodiments will now be described. However, it should be realised that the invention is not to be confined or restricted to the features of these embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

These embodiments are illustrated in the accompanying drawings in which;

Figure 1 shows a perspective view of an induction air handling unit with a linear outlet,

Figure 2 shows a schematic cross-section view of the induction unit shown in Figure 1,

Figure 3 shows a second embodiment of an induction air handling unit with a square register,

Figure 4 shows a schematic cross-section view of the induction unit shown in Figure 3,

Figure 5 shows a perspective view of an induction air handling unit incorporating a light fitting, and

Figure 6 shows a schematic cross-section of the induction unit shown in Figure 5.

DETAILED DESCRIPTION

Referring to Figures 1 and 2, the induction unit 10 comprises a chamber 11 with an inlet 12. In these embodiments, the chamber 11 is sheet metal construction and is provided with flanges 13 for mounting the induction unit 10 in a ceiling or wall space. As an alternative, the chamber 11 may be constructed of other materials such as sandwich-foam sheets or fibre reinforced plastics.

A plurality of nozzles 14 provide an outlet of air from the chamber 11. In this embodiment, the nozzles 14 are small moulded plastic nozzles attached to chamber 11 that result in a jet of air being directed away from the nozzle 14 when supply air is provided under pressure to the chamber 11. Alternatively, the nozzles 14 may be pressed or drawn in metal, or formed integrally with the chamber 11. The inlet 12 connects to ducting that provides supply air under pressure from a central or local air-conditioning plant.

As seen in Figures 2, 4 and 6 the induction unit 10 is mounted in a ceiling space. The partition comprises a ceiling 15 and the outlet 16 is mounted within the ceiling 15.

Supply air entering the chamber 11 under pressure leaves the chamber 11 via nozzles 14 as discrete jets. These jets of primary air are directed towards the outlet 16. The primary jets induce the flow of secondary air from the ceiling space so that the air flowing from outlet 16 is a combination or mixture of primary and secondary air.

The outlet 16 in Figure 1 comprises an elongate opening formed by two edge members 17 and a central guide 18. The edge member 17 is curved and together with central guide 18 directs the air flow in a substantially lateral direction away from the outlet 16. This arrangement assists in distributing conditioned air away from the outlet 16 by causing it to remain attached to the ceiling 15 due to the "Coanda effect" until its momentum is dissipated at which time it then descends down into the

occupied space below the ceiling 15. This provides more even mixing and prevents dumping of cold air into a room.

A pair of walls 20 are attached to the upper edges of each member 17 and extend upwardly along their length towards the chamber 11. A gap 30 is formed between the walls 20 and the chamber 11. End brackets 21 are secured to and extend away from the edge members 17 with the upper end of the end brackets 21 attached to the chamber 11. The outlet 16 is thereby mounted to the chamber 11.

Supply air entering the chamber 11 under pressure leaves the chamber 11 via nozzles 14 as discrete jets. These jets of primary air are directed towards the outlet 16. They induce a flow of secondary air from within the ceiling chamber through the gaps 30 so that the air flowing out of the outlet 16 is a combination of primary and secondary air.

In this embodiment, the partition comprises a ceiling 15. The first region above the ceiling is referred to as the ceiling space and the second region below the ceiling is the room or space into which the mixture of primary and secondary air flows. A portion of the conditioned air returns to the ceiling space. This is either by way of additional ducting or via apertures or slots within the ceiling 15. The air that returns to the ceiling space becomes the secondary air which is induced by the primary air exiting the nozzles 14.

The outlet 16 shown in the second embodiment of Figures 3 and 4 comprises a conventional square register 24. Walls 20 are mounted to the periphery of the register 24 and extend towards the chamber 11. Brackets 25 connect the walls 20 to the chamber 11 so that a gap 30 is left between the chamber 11 and the walls 20. Secondary air flows through this gap 30. A plurality of nozzles 14 are arranged in two rows which are generally directed around the periphery of the register 24. One row or more than two rows may be used. As seen in Figure 4 a sheet metal structure

26 is used to fill the centre region of the register 24 so that jets of air leaving the nozzles 14 are not able to disburse and thereby reduce velocity.

As an alternative, instead of the nozzles 14 comprising two rows that are directed around the periphery of the register 24, additional nozzles may be attached to the chamber 11 in the centre region. In this embodiment, there would be no need to make use of the structure 26.

Further, the structure 26 may be opened at its upper end rather than closed as shown in Figure 4. This would allow secondary air to also be drawn from within the conditioned space so that it flows through the centre of the register 24 through the structure 26 to join the primary air flow from the nozzles 14. In this case the gap 30 may not be required and the walls 20 would extend to the chamber 11.

Figures 5 and 6 illustrate a light fitting 32 located between two outlets 16. The light fitting 32 comprises a light housing 33 within which fluorescent tubes 34 are operatively mounted.

The chamber 11 has two rows of nozzles 14 which are directed towards the outer edges of the housing 33. Primary air is provided to the chamber 11 in the manner similar to the embodiments shown in Figures 1 to 4.

The outlets 16 are formed by a single curved edge member 17 and a guide 18 that direct the air flows from the outlet 16 sideways and away from the induction unit 10. A second wall 35 extends upwardly from the guide 18 and the nozzles 14 are directed at the space between walls 20 and 35. The primary air flow from the nozzles 14 induces secondary air flow through the gaps 30 on both sides of the induction unit 10.

As with the previous embodiments, the secondary air flow may be induced from within the ceiling space and may flow into the ceiling space via other air inlets (not drawn).

Alternatively, the secondary air may flow from the conditioned space through a gap between the light fitting housing 33 and the second wall 35. In this case, the gaps 30 may be closed completely so that only secondary air may flow into the induction unit 10 via the gap between the housing 33 and the second wall 35.

In a further alternative, the light fitting 32 may be replaced with a perforated plate or grill (not drawn) and the secondary air stream will be induced into the induction unit 10 through this perforated plate or grill. Given that the mixture of secondary and primary air exiting the outlet 16 is pushed sideways, then there should be minimal mixing of this air with the secondary air flowing through the perforated plate or grill.

All of the embodiments described show ceiling mounted units. However, it will be readily understood that wall or floor mounted units could also be used. In this arrangement the partition would comprise a wall or a floor.

As will be seen from the above description, the invention provides a unique method of increasing air flow from an outlet by combining a primary air flow with a secondary air flow. The invention is particularly suited to air-conditioning requirements where the invention will minimise noise output and provide a greater degree of control for air-conditioning rooms.